

## REMARKS / ARGUMENTS

Applicants thank the Examiner for the Office Action of December 9, 2005. This Amendment is in full response thereto. With this amendment, claims 9, 11-12, 14, 17, 19-20, 22, 25, 27-28, 30, 33, 35-36, and 38 are amended. In order to explicitly include antecedent basis for recitation of a "substrate" or "at least one substrate", various claims have been amended in accordance therewith. The Specification is also amended.

In the Office Action, the Examiner objected to the Specification as having a non-descriptive title. As suggested by the Examiner, Applicants have amended the title to recite: METHODS FOR PRODUCING SILICON NITRIDE FILMS AND SILICON OXYNITRIDE FILMS BY THERMAL CHEMICAL VAPOR DEPOSITION. As such, it is believed that the objection has been overcome.

In the Office Action, the Examiner rejected claims 9-40 under 35 USC 103(a) as obvious over U.S. 6,821,825 (Todd et al.). Applicants respectfully traverse the rejection for any one or more of the following reasons: a) Todd et al. fails to disclose, teach or suggest all of the claim limitations, b) the Examiner has not shown any evidence that the prior art recognizes the flow rate ratio between trisilylamine (TSA) and ammonia ( $\text{NH}_3$ ) as a result-effective variable, and c) the invention has produced unexpected results with respect to the reaction temperature of  $\leq 600^\circ\text{C}$ .

Applicants note the Examiner's recitation of lines 1-4 of column 10 of Todd et al. However, Applicants point out that Todd et al. teaches the silicon-containing films are produced using a precursor that is a higher-order, non-halogenated hydride of silicon (lines 13-27 of column 5). Applicants also note the Examiner's recitation of lines 13-45 of column 15. Applicants further point out that Todd et al. teaches that the higher order silanes may be used in conjunction with an oxygen source and a nitrogen source to form silicon oxides or silicon oxynitrides. While Todd et al. discloses that the nitrogen sources include TSA, atomic nitrogen,  $\text{NH}_3$  and  $\text{NF}_3$ , Applicants respectfully assert that Todd et al. does not disclose, teach or suggest use of both ammonia and TSA as the nitrogen source.

The entirety of the teachings of a prior art reference should be considered by the Examiner in an obviousness rejection instead of just isolated teachings. So, when presented with the teachings of Todd et al., one of ordinary skill in the art would likely consider Todd et al. to teach the deposition of SiON films using a

higher order silane precursor with an oxygen source and  $\text{NH}_3$  or **alternatively** TSA (among others). In contrast, such a one would likely not consider Todd et al. to teach the deposition of SiON films using both  $\text{NH}_3$  and TSA. As such, Todd et al. fails to disclose, teach or suggest all of the limitations of claims 12-15, 20-23, 28-31, and 36-39.

While Applicants note Todd et al.'s teaching of SiN film deposition at lines 45-67 of column 14, they respectfully assert that it fails to disclose the use of TSA and  $\text{NH}_3$  together. Rather, similar to the above-reference teaching of SiON film depositions, one of ordinary skill in the art would likely view TSA and  $\text{NH}_3$  as being **alternative** sources of nitrogen. As such, Todd et al. fails to disclose, teach or suggest all of the limitations of claims 9-11, 16-19, 24-27, 32-35, and 40.

With particular respect to claims 9-10, 16-18, 24-26, 32-34, and 40, the Examiner has provided a legally insufficient obviousness rejection on the basis of optimization of the TSA: $\text{NH}_3$  flow rate ratio. As held by the Federal Circuit, there would be no expectation that optimization of a parameter would yield the desired improvement if the prior art does not recognize the parameter as a result-effective variable. In re Antonie, 559 F.2d 618, 619, 195 U.S.P.Q. 6, 8 (C.C.P.A. 1977). In this case, the Examiner has not pointed to any portion of the prior art that recognizes the TSA: $\text{NH}_3$  flow rate ratio as a result-effective variable. If the Examiner is aware of such a hypothetical teaching, Applicants kindly request that reference because, in the absence of a specific teaching, Applicants are not fully able to argue their position. Finally, Applicants point out that in order to optimize a parameter, a particular starting value (from which the parameter is optimized) must be disclosed by the prior art. In the instant rejection, the Examiner has not pointed to any portion of the prior art disclosing a TSA: $\text{NH}_3$  flow rate ratio.

Similarly, the Examiner has provided a legally insufficient obviousness rejection of claims 10-15, 18-23, 26-31, and 34-39 on the basis of optimization of the reaction temperature. Id., at 619, at 8. This is because the Examiner has not pointed to any portion of the prior art that recognizes the reaction temperature as a result-effective variable. Again, the Examiner has not pointed to any portion of the prior art disclosing a temperature of a reaction between TSA and the other gas as variously claimed.

Finally, with respect to claims 10-15, 18-23, 26-31, and 34-39, Applicants believe that the invention has produced unexpected results with respect to the reaction temperature range of  $\leq 600$  °C. Applicants kindly direct the Examiner's attention to Figure 5 and lines 1-11 of page 15 of the specification where it is seen

that a relatively great drop off in thermal stability for TSA occurs when the reaction temperature exceeds 600 °C. Conversely, in comparison to these higher reaction temperatures, TSA is unexpectedly thermally stable at temperatures equal to or below 600 °C. As such, Applicants believe the rejection of claims 10-15, 18-23, 26-31, and 34-39 has been overcome.

In the Office Action, the Examiner also rejected claims 9-40 under 35 USC 103(a) as obvious over JP 06338497 A (Ishikawa). Applicants respectfully traverse the rejection because the Examiner has presented a legally insufficient rejection on the basis of optimization of the TSA:NH<sub>3</sub> flow rate ratio and reaction temperature parameters for the same reasons explained above with regard to the rejection of claims 9-40 over Todd et al.

In the Office Action, the Examiner also rejected claims 9-40 on the ground of non-statutory obviousness-type double patenting over claims 1-32 of U.S. 6,936,548 (Dussarrat et al.) on the basis that the silicon precursor required by the claims is putatively an obvious variation. Applicants respectfully traverse the rejection because the silicon-containing precursors of Dussarrat et al. and of claims 9-40 of the present application are not similar in structure such that one of ordinary skill in the art would expect them to have similar properties.

Dussarrat et al. claims a variety of silicon-containing precursors within the formula: (R<sup>0</sup>)<sub>3</sub>-Si-Si-(R<sup>0</sup>)<sub>3</sub>, where at least one of the R<sup>0</sup> groups comprises NR<sup>1</sup>R<sup>2</sup> and one of the R<sup>1</sup> and R<sup>2</sup> is a C<sub>1-4</sub> hydrocarbyl. In contrast, TSA has the formula Si(NH<sub>2</sub>)<sub>3</sub>, a significantly different structure. For example, the Dussarrat et al. precursor has one to four carbon atoms, while TSA has none. Also, the Dussarrat et al. precursor has two silicon atoms, while TSA has only one. There are many more differences which would be readily apparent to one of ordinary skill in the art such that his or her likely conclusion would be that the two precursors are not obvious variants. As such, Applicants believe that this rejection should be withdrawn.

The rejection over Dussarrat et al. should also be withdrawn because the claims of Dussarrat et al. fail to disclose, teach or suggest the TSA:NH<sub>3</sub> flow rate ratio and reaction temperature parameters as variously required by the claims and as explained in detail above.

In the Office Action, the Examiner also rejected claims 9-40 on the ground of non-statutory obviousness-type double patenting over claims 1-8 of U.S. 6,365,231 (Sato et al.). Applicants respectfully traverse the rejection because the methods claimed by Sato et al. do not recite the TSA:NH<sub>3</sub> flow rate ratio and reaction temperature parameters as variously required by the claims. The Examiner has also failed to point to any prior art teaching a ratio and/or reaction temperature as well as a prior art recognizing that the ratio and temperature are result-effective variables.

Should the examiner believe an additional telephone call would expedite the prosecution of the application, he is invited to call the undersigned attorney at the number listed below. A petition for a one month extension of time is contemporaneously submitted with this Amendment. Otherwise, it is not believed that any fee is due at this time. If that belief is incorrect, please debit deposit account number 01-1375. Also, the Commissioner is authorized to credit any overpayment to deposit account number 01-1375.

Respectfully submitted,



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**CERTIFICATE OF TRANSMISSION UNDER 37 CFR 1.8(a)**

I hereby certify that this correspondence is being transmitted via facsimile to telephone number 571-273-8300 on this 10th day of April, 2006.

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Christopher J. Cronin